

Is Fluoride Only in Drinking Water?

As a rule, when looking at fluoride uptake, only the ingestion through drinking water is considered. However, studies conducted in the Ethiopian Rift Valley revealed that the uptake with food becomes important through the water used for cooking.

Ruth Scheidegger¹, Meseret Desalegne², Marian K. Malde³, Alexandra Huber¹, Lars Osterwalder⁴, Hans-Peter Bader¹, Feyisa Lemma⁵, Tesfaye Edosa⁵

Safe drinking water is often associated with water boiling. It is believed that once water has been boiled it poses no further health risk. This is correct if the contamination is microbiological. However, this is incorrect in the case of a geogenic contamination with fluoride or arsenic. A geogenic contamination can only be removed from water through filtering or other treatment options. To plan the most appropriate removal option, it is important to determine the amount of fluoride ingested by a person. An uptake analysis based on material/substance flow analysis (MFA/SFA) allows to distinguish between fluoride intake through food and beverage. The analysis will reveal whether treating only drinking water is sufficient, or if all water used has to be treated, and to what extent the ingredients themselves pose a problem.

Uptake analysis

In three different villages in the Ethiopian Rift Valley, interviews were conducted with 20 families on their daily diet over the past seven days. In the same interviews, the persons responsible for preparation of meals were also asked about the recipes they use to prepare the dishes.

Based on these interviews, a master thesis was conducted in nine households. The women in charge of cooking were asked to prepare a selection of the most common dishes. This preparation was closely observed and all ingredients were weighted prior to their use, including the cooked dish. This allowed to determine

more accurately the recipe of the dishes. Samples of all ingredients were collected, as well as part of all the dishes prepared and subsequently analysed for fluoride.

Results

This combined field study resulted in an:

1. Assessment and description of an average daily diet in three villages in the Ethiopian Rift Valley.
2. Estimation of the average daily fluoride uptake by linking the dishes of the diet to the ingredients of the recipes.

A simple model [1], developed previously for a study on the daily diet of children living in the Rift Valley [2], was used to calculate fluoride uptake.

The calculations were conducted with water from the Chalaleki and Gura windmills and with piped water from Mesken Sefer (situated in Weyo Gabriel village) with a fluoride content of 17 mg/l, 10 mg/l and 3 mg/l. The average fluoride uptake through food and beverages amounted to 40 mg F/day/person (Chalaleki), 25 mg F/day/person (Gura) and 11 mg F/day/person (Mesken Sefer). The results revealed that food is an important source of fluoride uptake, as 40 %, 44 % and 59 % of the total uptake comes from food in the three villages (Fig. 1).

According to WHO guidelines, an uptake exceeding 6 mg F/day poses an increased risk of affecting the skeleton, 14 mg F/per day are a clear excess risk of skeletal adverse effects. The SCSEDRI (Standing Committee on the Scientific Evaluation

of Dietary Reference Intakes) suggests an UL (tolerable upper intake level) of 10 mg/day for children older than eight years and adults. Considering SCSEDRI's UL and the stricter WHO guidelines, all the results obtained reach or exceed the threshold levels when using only untreated water.

By treating the drinking water (using the Nakuru Technique (cf. article on page 10) to an average concentration of 0.75 mg F/l fluoride uptake could be reduced by 57 %, 51 % and 29 %. If all the drinking and cooking water is treated by the Nakuru Technique to a concentration of 0.75 mg F/l, the uptake could be further reduced by 66 %, 52 % and 21 %. Only if both drinking water and water used for cooking are replaced by water filtered with the Nakuru technique, the daily uptake is reduced to 6 mg F/day/person. The remaining fluoride uptake of 6 mg/day/person comes from food ingredients. To reduce this uptake further, the contributions from the different ingredients have to be studied in more detail.

However, little is known about the bio-availability of fluoride, such as for example minerals in the diet that could reduce bio-availability. More studies are needed to determine the part of fluoride in drinks and food that is absorbed and poses a risk of developing fluorosis. The described analysis is a first assessment to further develop potential fluoride reduction options.

- [1] Malde, M.K., Scheidegger, R., Julshamn, K., Bader, H.-P. (2011): Substance Flow Analysis: A Case Study of Fluoride Exposure through Food and Beverages in Young Children Living in Ethiopia, *Environmental Health Perspectives* 119 (4); 579–584.

- [2] Malde, M.K. (2002): Dietary Fluoride Sources in Areas with Endemic Fluorosis. PhD Thesis, Department of Odontology, University of Bergen, Norway.

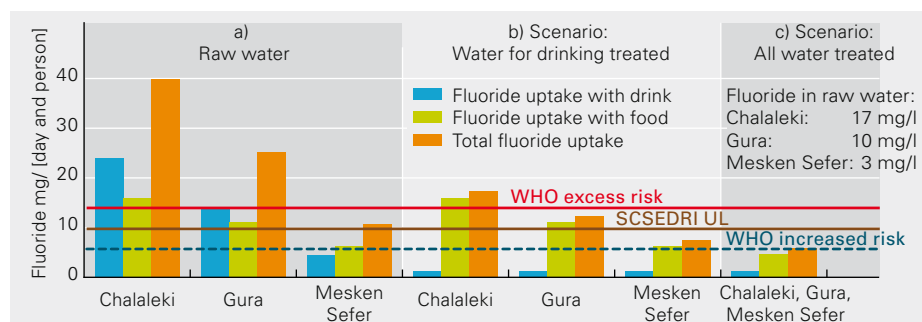


Figure 1: Calculation of uptake through average diet in three different villages (note that Mesken Sefer is situated in the Weyo Gabriel village). a) Raw water, b) Scenario with treated water for all drinks and c) Scenario with treated water for drinks and food.

¹ Eawag/Siam, Switzerland

² Dept. of Chemistry, Addis Ababa University

³ National Institute of Nutrition and Seafood Research, Bergen, Norway

⁴ Eawag/Water Resources and Drinking Water, Switzerland

⁵ Oromo Self-Help Organization, Ethiopia (OSHO)

Contact: ruth.scheidegger@eawag.ch